

# Behavior of Compressive and Flexure Strength in High Performance Concrete using Steel Fiber and Polyethylene Fiber for Concrete Structure

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## ABSTRACT

Concrete is powerful in pressure yet feeble in strain and fragile moreover. Breaks additionally start framing as fast in light of the fact that the substantial is found. These three downsides don't permit the utilization conventional cement in asphalts as they cause absence of flexibility alongside break and disappointment. These shortcomings in cement might be relieved via the utilization of strands as support in the substantial blend. Squander substances looking like polyethylene and tires reason ecological contamination which prompts various wellness issues. Polyethylene and waste tires can be reused and utilized productively in the substantial as support in the fiber structure. Polyethylene is an engineered hydrocarbon polymer that may improve the malleability, power, shrinkage characteristics, etc. This paper offers with the impacts of expansion of polyethylene fiber on the places of cement. Polyethylene and tire filaments have been cut into the components of 30mm x 6mm and that they were utilized 1.5% each by utilizing amount. Evaluation of cement utilized were M30, M35 and M40. IRC 44:2008 changed into noticed for the design of substantial mix. In this notice, the outcomes of the Strength homes of Polyethylene fiber reinforced cement had been provided. 4 point twisting investigate were refined in the lab for flexure judgments. There changed into apparent a blast of 18% inside the multi day compressive force close by a development of 39% in flexure and 32% in shear power. 22% lower in 4 point twisting check and 36% diminishing in avoidance diverted into discovered from the examinations. Hypothetical assessment of redirection changed into performed via the help of power procedures. Reasonable qualities were affirmed with the hypothetical qualities inside as far as possible. At long last it very well may be reasoned that polyethylene and tire might be utilized effectively in fortified concrete cement.

**KEYWORDS:** Compressive strength, Flexure strength, Slump value, polyethylene fiber, Tire Fiber, Deflection

## 1. INTRODUCTION:

For a developing state comprehensive of India, assume a urgent part in street networks giving a solid and pleasant surface for vehicles. Asphalts are generally made utilizing bitumen. In any case, insure circumstances of substantial street asphalts are likewise liked. Various fragments were examined for accommodating usage of concrete as a clearing material. A recurring pattern analyze has exhibited that fiber strengthened concrete (FRC) may be used for the advancement of pavements as it's miles discovered to be incredible in quality and it moreover doubtlessly comprehended shows assorted commendable properties.

Plastics are extremely solid and non-biodegradable in nature. The compound bonds in plastics make it incredibly durable and impenetrable to normal regular procedures of debasement. The day by day utilization of plastics has expanded quickly and it has become a typical propensity for individuals to simply toss out the plastic and causing ecological contamination. More than 1 billion tons of plastic

have been delivered since 1950s, and the equivalent is probably going to stay as such for a long time. These squanders get blended in with MSW or they are basically tossed making disturbance the general public. There is a major need of reusing of the plastics also squander tires since we don't have some other choice of arranging them without getting climate from contamination. For instance, there are two cycles for the removal of squanders: land filling and cremation. In the event that the squanders are basically unloaded, they cause soil and water contamination and on the off chance that they are burned, they cause air contamination. Henceforth, there is a need to reuse the losses into something valuable which won't hamper the climate and the cycle where it is utilized.

## 2. Objectives

The objectives of the research are outlined below:

- To achieve the desire strength in high performance concrete.

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- To find out the dosage of the Waste polyethylene and tire fibers at which the concrete gain the higher strength.
- Determination of the compressive strength Concrete and flexural strength of conventional concrete beams, Deflection of the concrete Beam.
- Waste polyethylene and tire fibers is also industrial waste by the use of it we can reduced the environmental degradation.

### 3. Literature Review

Chips away at squander materials are talked about in the ensuing headings extensively.

Hasan, M.J., Afroz, M., and Mahmud, H.M.I. (2018) "An Experimental Investigation on Mechanical Behavior of Macro Synthetic Fiber Reinforced Concrete," International Journal of Civil and Environmental Engineering, Vol. 11, Concrete is an unquestionable material for the development of different sorts of designs in the cutting edge progression of common frameworks. Concrete is solid in pressure however feeble in strain and shear. To wipe out those issues, the presentation of fiber was acquired as an option in contrast to creating concrete considering upgrading its malleable and shears strength just as improving its pliable property. Consequently, the motivation behind this examination was to explore the mechanical conduct of cement built up with full scale (primary) engineered filaments. To decide these properties test work was completed. Four bunches of cement were projected: one without any strands and the leftover three with three diverse volume parts filaments of 0.33, 0.42 and 0.51%, separately. Substantial examples (blocks, crystals and pillars) were cast to decide the mechanical conduct, for example, compressive, pliable, shear strength and stress-strain connections. Test outcomes showed that large scale engineered fiber improved the compressive strength irrelevantly. Nonetheless, large scale engineered filaments at 0.33, 0.42 and 0.51% volume divisions improved the rigidity by at any rate 10, 15 and 14%, separately, contrasted with the control example. Essentially a definitive shear strength was expanded fundamentally by at any rate 15, 45 and 65% for full scale manufactured strands of 0.33, 0.42 and 0.51% volume portions, separately, contrasted with the control radiates. The disappointment of plain substantial examples was unexpected (fragile) for both the malleable and shear strength tests. Nonetheless, the substantial built up with full scale manufactured filaments showed more bendable conduct contrasted with the plain concrete. Full scale manufactured strands improved a definitive strain esteem by in any event 50, 60 and 60% for large scale filaments of 0.33, 0.42 and 0.51% volume divisions, individually.

Omanakuttan Athira, An Experimental investigation on Strength Behavior of Steel Fiber, Glass Fiber with Fly Ash and Rice Husk Ash (IJARIIT-2017) ISSN: 2454-132, Hybrid Fiber-supported cement is a composite material comprising of combinations of concrete, fine total, coarse total, steel fiber and glass fiber. The half breed fiber supported substantial displays better exhaustion strength and expanded static and dynamic rigidity. In this task, the strength of fiber supported cement was explored with halfway supplanting of concrete with rice husk debris and fly debris. Steel fiber and glass fiber was included the request for 0.25%, 0.5% and 0.75% by volume of concrete and

0.25%, 0.5% and 0.75% by weight of concrete. Rice Husk Ash was utilized to supplant conventional Portland concrete by 20% and fly debris 20% by weight of concrete extent, Aswani Sabu, Thomas Paul, International Journal for Research in Applied Science and Engineering Technology (IJRASET) Volume 4 Issue IX, September 2016, Fibers are by and large utilized as a typical designing material for break opposition and fortifying of cement. Their properties and attributes extraordinarily impact the properties of substantial which has been demonstrated effectively in numerous past explores. In like manner it has been discovered that steel strands invigorate the most extreme in contrast with glass and polypropylene filaments. In this exploratory examination, two sorts of steel strands in particular snared end and pleated filaments are utilized. The volume parts taken are 0.75%, 1.0% and 1.25% and M30 grade concrete is received. Concrete has been supplanted with 25% of Class F flyash. The essential center is to analyze the mechanical properties of substantial utilizing the two filaments,

R. Madheswaran, S. Arun Singh, K.S. Sathyanarayanan International Journal of Civil Engineering and Technology (IJCIET) Volume 5, Issue 5, May (2014), pp. 114-122, Concrete is presumably the most broadly utilized development material on the planet. The fundamental fixing in the traditional cement is Portland concrete. The measure of concrete creation produces roughly equivalent measure of carbon dioxide into the air. Concrete creation is devouring huge measure of regular assets. That has carried pressing factors to lessen concrete utilization by the utilization of strengthening materials. Accessibility of mineral admixtures checked opening of another period for planning substantial blend of increasingly elevated strength. Fly Ash and silica seethe is another mineral admixture, whose potential isn't completely used. Also just restricted examinations have been done in India on the utilization of silica rage for the improvement of high strength concrete with expansion of steel filaments. The investigation centers around the compressive strength execution of the mixed cement containing distinctive level of silica smoke and Fly Ash and steel fiber as an incomplete substitution of OPC. The concrete in concrete is supplanted in like manner with Silica rage content was use from 0% to 10% in the timespan in weight premise and furthermore fly debris content was use from 10% in weight premise. So to improve the strength of substantial steel filaments were added 0.5%, 1%, 1.5%, 2% by weight of steel fiber. Substantial solid shapes are tried at the age of 3, 7, and 28 days of restoring. At last, the strength execution of Fly debris and silica rage mixed fiber supported cement is contrasted and the exhibition of ordinary cement. From the exploratory examinations, it has been seen that, the ideal substitution Fly debris and silica smoke to concrete and steel fiber without changing a lot of the compressive strength is 10% - 8 % and 1.5 % individually for M25 grade Concrete

### 4. Base Materials

#### ➤ Basic materials

The basic materials which compose concrete are:

1. Water
2. Cement
3. Fine aggregate
4. Coarse aggregate
5. Admixture (Plasticizer)

In case of polymer fiber reinforced concrete fibers are added. For this experiment 2 types of fiber are chosen. The fibers to be used in the concrete mix are:

1. Polyethylene fiber
2. Tire (Steel) fiber

#### A. Water

Water is the main material in concrete. It plays out the accompanying jobs in substantial framework:

- It gives concrete the following property. The quality, amount, solidness and pace of arrangement of the sticky material that ties the totals rely upon the quality and amount of water added.
- It additionally controls the usefulness of cement. The more the water content (up as far as possible) the more is the usefulness.
- The mechanical properties of solidified concrete as compressive, flexural strength and durability additionally rely upon hydration results of concrete and there by rely upon water content.
- The pliancy of cement relies upon the water content.
- Water is likewise required for restoring of solidified cement to assist concrete with obtaining its necessary strength.

#### B. Conventional Portland concrete (OPC)

It is an ordinary concrete made by consuming calcareous (Calcium carbonate) and argillaceous (Clay) together at an exceptionally high temperature and afterward pounding the subsequent calcined item known as clinker with brief measure of gypsum (for faster solidifying) into fine powder.

#### C. Fine Aggregate

Ordinary sand is for the most part utilized as the fine total. Sometimes quarry residue or residue from stone smashers are likewise utilized as fine total. It adds to a significant part of substantial framework. Both normal and fake sand can be utilized as fine total.

#### D. Coarse Aggregate

It is for the most part includes squashed stones like rock. Now and again rock or broken blocks are likewise utilized as coarse totals. Coarse total possess the most piece of the substantial framework and contribute toward weight and strength of the solidified cement.

#### E. Filaments

These are short discrete materials, might be metallic or polymeric, utilized as creating support for substantial designs. These are blended in with different segments of cement to shape the grid and add certain properties to it.

#### F. Readiness of strands

The polythene utilized in milk bundles is utilized as crude material for readiness of the fiber. These polythene bundles are gathered; they are washed and cleaned by placing them in

steaming hot water for 3-4 hours. They are then dried. Additionally squander tires are gathered. The steel wires inside them are striped out of the tires. They are washed in serious trouble and afterward dried.

#### 5. Methodology

To examine the different boundaries of polymeric fiber support substantial that influence the help life of an asphalt with insignificant upkeep, the accompanying trials are should have been completed.

##### 1. Test of aggregates

- A. Abrasion resistance of aggregates
- B. Impact resistance of aggregates
- C. Crushing resistance of aggregates

##### 2. Test of concrete

- A. Physical inspection of concrete
- B. 28 day compressive strength test
- C. Flexural strength test

The flexural strength test to be conducted is 2-point load test (4-point bend test)

#### A. Casting and curing

Standard sized cubes (150mm x 150mm x 150mm) are casted for compression test of concrete. The beams casted are however different than standard size. The beams are casted with dimension 500mm x 100mm x 75mm.

#### B. Samples casted:

##### I. Cubes

1. 3 numbers of M30 conventional concrete
2. 3 numbers of M35 conventional concrete
3. 3 numbers of M40 conventional concrete
4. 3 numbers of M30 fiber introduced concrete
5. 3 numbers of M35 fiber introduced concrete
6. 3 numbers of M40 fiber introduced concrete

##### II. Beams

1. 6 numbers of M30 conventional concrete
2. 6 numbers of M35 conventional concrete
3. 6 numbers of M40 conventional concrete
4. 6 numbers of M30 fiber introduced concrete
5. 6 numbers of M35 fiber introduced concrete
6. 6 numbers of M40 fiber introduced concrete

Total 18 numbers of cubes and 36 numbers of beams are casted. They are allowed to stay in the mould for 24 hours. Then they are immersed in water for curing. After 28 days they are taken out from water, dried and then tested.

#### 6. EXPERIMENTAL WORK

##### A. Compressive Strength Test

The compressive strength test is the most important test done on the concrete as it determines the characteristic strength of the concrete which represents the resistance of concrete against crushing load. The casted cubes are tested for compressive strength in the compression testing machine.

**Table 1: Compressive strength of conventional concrete cubes**

Grade of Concrete	Specimen no	Failure Load (tons)	Compressive Strength (N/mm <sup>2</sup> )	Mean Compressive Strength (N/mm <sup>2</sup> )
M30	1	83	36.88	37.18
	2	84	37.33	
	3	84	37.33	
M35	1	95	42.22	42.66
	2	97	43.11	
	3	96	42.66	
M40	1	104	46.22	46.96
	2	108	48	
	3	105	46.66	

**Table 2: Compressive strength of fiber introduced concrete cubes**

Grade of Concrete	Specimen No.	Failure Load (tons)	Compressive Strength (N/mm <sup>2</sup> )	Mean Compressive Strength (N/mm <sup>2</sup> )	Strength Gain (%)
M30	4	99	44	43.85	17.93
	5	99	44		
	6	98	42.56		
M35	4	111	49.33	49.48	15.98
	5	112	49.78		
	6	112	49.78		
M40	4	124	55.11	54.57	16.1
	5	122	54.22		
	6	122	54.22		

**Table 3: Load and deflection of conventional concrete and fiber introduced concrete beams (M30)**

Conventional concrete		Fiber introduced concrete	
Load (KN)	Deflection (mm)	Load (KN)	Deflection (mm)
0	0	0	0
1	0.006	1	0.004
2	0.018	2	0.013
3	0.034	3	0.024
4	0.056	4	0.036
5	0.072	5	0.042
5.47	0.088	6	0.051
		7	0.062
		7.53	0.071

**Table 4: Load and deflection of conventional concrete and fiber introduced concrete beams (M35)**

Conventional concrete		Fiber introduced concrete	
Load (KN)	Deflection (mm)	Load (KN)	Deflection (mm)
0	0	0	0
1	0.018	1	0.008
2	0.032	2	0.017
3	0.044	3	0.026
4	0.061	4	0.031
5	0.078	5	0.037
5.66	0.086	6	0.044
		7	0.052
		7.92	0.065

**Table 5: Load and deflection of conventional concrete and fiber introduced concrete beams (M40)**

Conventional concrete		Fiber introduced concrete	
Load (KN)	Deflection (mm)	Load (KN)	Deflection (mm)
0	0	0	0
1	0.011	1	0.007
2	0.018	2	0.013
3	0.031	3	0.024
4	0.048	4	0.031
5	0.063	5	0.038
5.91	0.079	6	0.046
		7	0.052
		8	0.061
		8.07	0.061

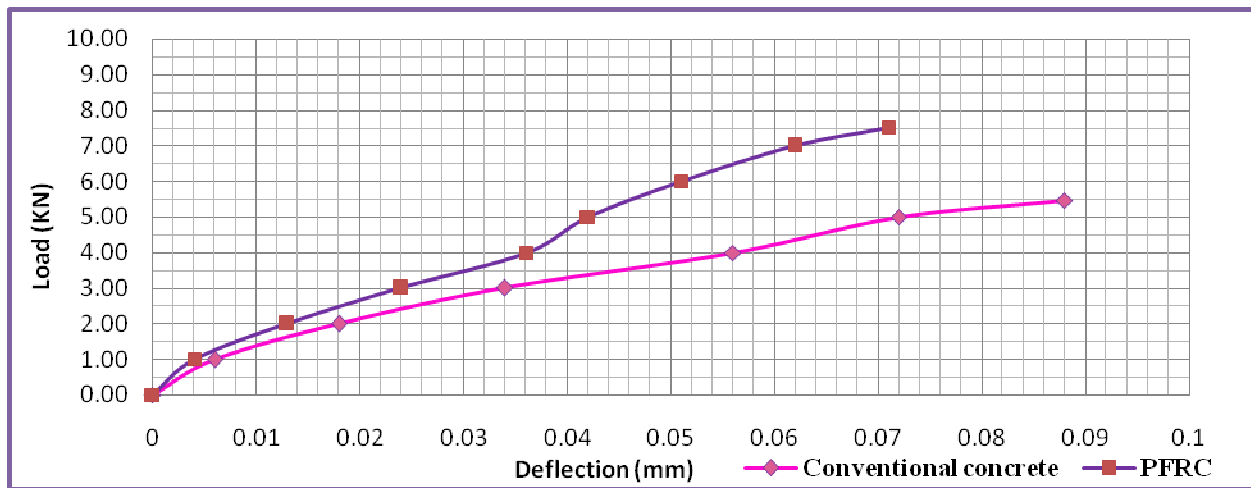


Fig-1: 4 Point bend test Load vs Deflection for M30 concrete

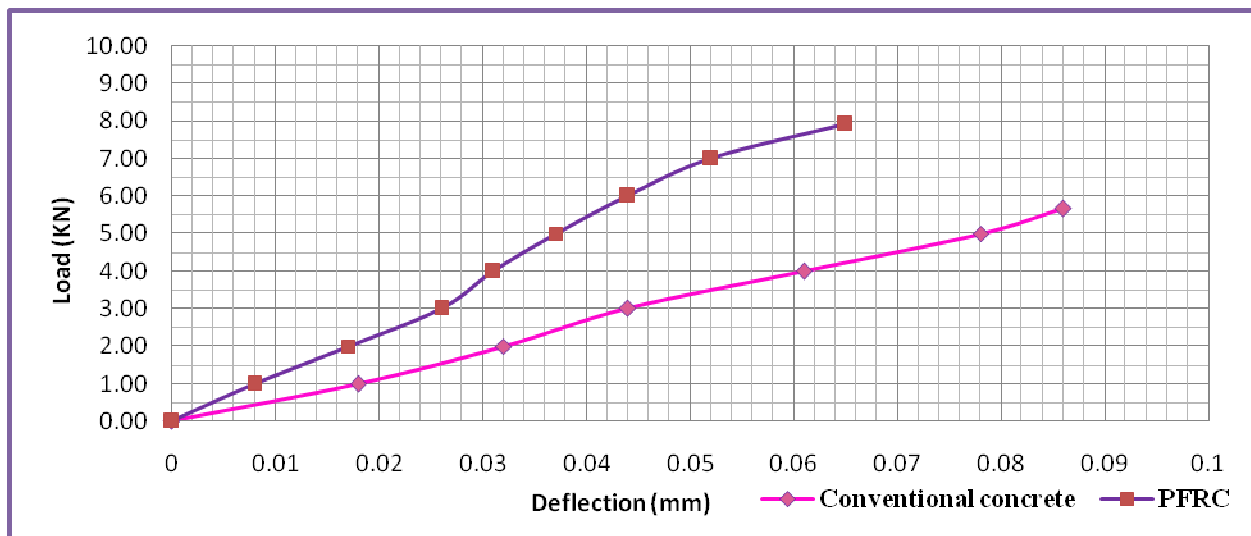


Fig-2: Point bend test Load vs Deflection for M35 concrete

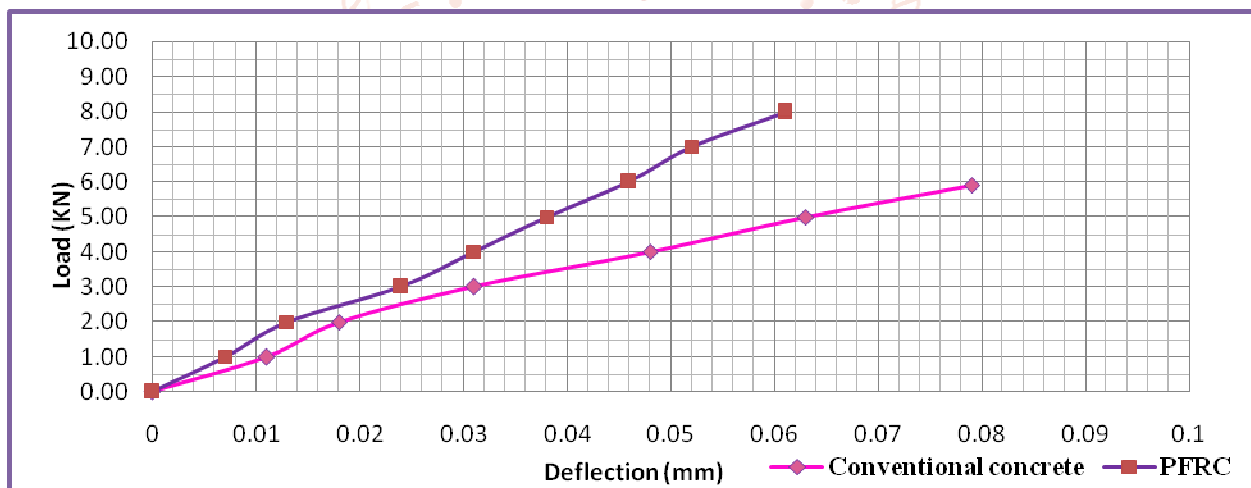


Fig-3: 4 Point bend test Load vs Deflection for M40 concrete

## 7. Conclusions

The accompanying derivations have been drawn from the tests done on concrete with polyethylene and tire strands:

There is an increase of 17.93%, 15.98% and 16.1% in compressive strength of M30, M35 and M40 grade concrete individually.

Gain in flexural strength were discovered to be 37.34%, 39.70% and 39.66% for M30, M35, and M40 separately. What's more, individual decrease in avoidance were 22.22%, 23.53% and 20.78%.

The level of variety of diversion in regular cement is

discovered to be 4.76%, 6.59% and 12.5% for M30, M35 and M40 individually and for fiber acquainted substantial it is found with be 13.7%, 17.3% and 19.31%.

From the previously mentioned discoveries it very well may be presumed that the squandered polyethylene and tire filaments can be utilized viably to decidedly impact the mechanical properties of the fiber supported cement.

## REFERENCES

- [1] Hasan, M. J., Afroz, M., and Mahmud, H.M.I. (2011) "An Experimental Investigation on Mechanical Behavior of Macro Synthetic Fiber Reinforced Concrete," International Journal of Civil and Environmental

Engineering, Vol. 11, No. 03

Building Materials 84 (2015) 354–366

- [2] Hoe Kwan Mahyuddin Ramli, Flexural strength and effect opposition investigation of fiber supported cement in mimicked forceful natural Construction and Building Materials 63 (2014) 62–71
- [3] Su-Jin Lee, Jong-Il Won Flexural conduct of precast built up substantial composite individuals supported with underlying nano-engineered and steel filaments Composite Structures 118 (2014) 571–579
- [4] Lijun Wang, Jing Zhang, Xu Yang, Chun Zhang, Wei Gong, Jie Yu Flexural properties of epoxy syntactic froths built up by fiberglass network or potentially short glass fiber Materials and Design 55 (2014) 929–936
- [5] Barzin Mobasher Yiming Yao, Chote Soranakom Analytical answers for flexural plan of half breed steel fiber supported cement footers Engineering Structures 100 (2015) 164–177
- [6] Ilker Fatih Kara , Ashraf F. Ashour , Mehmet Alpaslan Korog'lu Flexural conduct of crossover FRP/steel built up cement footers (2015) "Composite Structures 129 (2015) 111–121
- [7] Maher A. Adam, Mohamed Said Analytical and trial flexural conduct of cement footers built up with glass fiber supported polymers bars Construction and Building Materials 84 (2015) 354–366
- [8] Wenjie Ge , Jiwen Zhang , Dafu Cao , Yongming Tu Flexural practices of crossover cement footers built up with BFRP bars and steel bars Construction and Building Materials 87 (2015) 28–37
- [9] Sumanta Das a, Alyson Hendrix Flexural crack reaction of a novel iron carbonate network – Glass fiber composite and its correlation with Portland concrete based composites Construction and Building Materials 93 (2015) 360–370
- [10] Doo-Yeol Yoo, Goangseup Zi,Yoon. Biaxial flexural conduct of super superior fiber-built up concrete with various fiber lengths and position techniques Cement and Concrete Composites (2015), doi: <http://dx.doi.org/10.1016/j.cemconcomp.2015.07.011>
- [11] Athira Omanakuttan An Experimental examination on Strength Behavior of Steel Fiber, Glass Fiber with Fly Ash and Rice Husk Ash, International Journal of Advance Research, Ideas and Innovations in Technology.201 ISSN: 2454-132X(P394-400)
- [12] I.S 10262-2009:"Recommended rules for substantial blend plan", 2009
- [13] I.S 12269-1987:"Specifications for 53 evaluation Ordinary Portland Cement", 1987

